9. COGNITION IN NATURAL SETTINGS: THE CULTURAL LENS MODEL

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ABSTRACT

Intercultural interactions, in domains such as civil aviation and international peacekeeping, expand awareness of national differences in cognition. At the same time, experience with national differences in natural settings provides a more complex picture of cognition. The Cultural Lens Model captures the nature and origin of the cognitive differences. This paper reviews cognitive dimensions that vary over national groups. It uses the Cultural Lens Model to describe the implications of these cognitive differences for five intercultural challenges: problem definition, planning, coordination, prediction, and training. Finally, the paper suggests mechanisms for increasing international effectiveness in the face of cognitive differences.

INTRODUCTION

International enterprises are becoming more common. Work environments are now likely to include professionals from Western nations – the United States, Western Europe, and the English-speaking world – as well as from other regions of the world. Equipment developed in one nation may be exported to distant regions. Business leaders work with their counterparts around the world. A typical

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Western hospital, research institution, or technical facility includes multinational professionals with varied training and backgrounds. Scientists can coordinate complex research efforts with colleagues they know only through the Internet. By assembling multinational groups they can tap a wider range of expertise. We now have unprecedented opportunities to share resources, extend perspectives, and expand markets.

We can benefit from globalization only as we can work with people from different nations. Human factors specialists and ergonomists see national differences in settings as varied as the space station, military and peacekeeping operations, commercial aviation, and global business. Professionals in these domains must detect problems, make sense out of complex and confusing information, plan, make decisions, and coordinate with others. At the same time they must manage the stress and uncertainty often endemic in these domains. In order to accomplish task demands, professionals need to understand how people from other nations perceive events, how they think about issues, how to anticipate their actions, how to influence their beliefs, and how to negotiate agreements.

The shift towards multinational operations, together with a growing complexity of work environments, presents a problem: *Intelligent and thoughtful people from different national groups sometimes identify different problems, make different plans, negotiate and coordinate differently, and make different decisions during complex cognitive tasks. Cutting edge technology and procedures, carefully and competently developed in one nation, may be incompatible with the equipment, procedures, and professional practices of other nations. Training packages that are effective in one nation can receive harsh criticism in others*. Professionals often struggle during interactions with competent, well-meaning peers from other nations. These problems can compromise productivity and the quality of work. Here are two examples:

> A pilot reported that a pump was not working. The maintenance crew is supposed to pinpoint the exact cause of the problem. But they didn't. They replaced three separate parts as they had done before. Had they gone to the manual, they would have seen that two of the parts were unnecessary. The shotgun approach is very costly in time and materials (Klein, H. A., Klein, G., & Mumaw, 2001, p. 17).

> Many citizens in Bosnia-Herzegovina have guns and explosive devices. Operation Harvest is a program to collect weapons in order to lower the risk of aggression. Some soldiers will act only when they have complete information, even if it means fewer collections. They want to meticulously script each home visit and specify many variations. Officers from other countries are critical of this caution. They want a general plan and the flexibility to respond to deviations along the way. This attitude troubles the first group of officers: "When we sit down to plan, they drive us nuts! They want to keep everything open. We have to make decisions and we should do it when we have the time to think!" (Klein Associates, 2002, p. 16).

These examples illustrate differences seen in natural settings between people from different nations. These differences alter how people collaborate in work settings and follow procedures. Participants in multinational interchanges often struggle with the seemingly strange, counterproductive, and/or dangerous actions of others. These can make it difficult to establish and sustain common ground during collaboration. There are two common explanations for such differences:

Explanation 1. People from some other nations are stupid, lazy, amoral, and/or obstructionist.

This explanation is usually couched in polite terms: "With the education they get, this is all we can expect." "They are just not used to working hard – look at their history." "They really don't seem to care about safety. Life is not valued as much in their country." "As soon as you take your eyes off them, they stop working. They haven't been taught responsibility." From this perspective, there are two solutions. You can try to change the people who are different from you. Alternately, you can use work-arounds to avoid giving critical tasks to personnel from "suspect" nations. Both solutions are found in aviation and multinational military operations.

The commercial aviation industry strives to provide the safest possible transportation regardless of the nationality of personnel or the carrier. Safety is emphasized through procedures and guidelines. This includes standardization of training and certification for pilots and maintenance technicians. Increased automation is, in part, a response to concerns about the variability in performance. It has not yet been possible, however, to make enough rules and specify enough procedures to protect this complex work setting.

In multinational military operations, Western officers are often placed in command of non-Westerners in order to avoid their "mistakes" and "misjudgments." Particularly important tasks may be diverted to Western teams. This solution can sometimes provide effective but costly stopgaps for routine operations. It does not, however, address the underlying problem of national differences. This problem can lead to performance breakdowns when people from different nations need to coordinate difficult tasks, particularly under time pressure. At the very least, it makes it difficult to fully use the strengths and expertise of some other nationals.

There is a second explanation that has guided my research on cognitive differences in natural settings:

Explanation 2. People from some other nations differ in cognition in ways that result in different perceptions, judgments, and decision making.

It is easy to assume others think as you do; that the cognition of others mirrors your own. People are easily insensitive to cognitive differences because cognitive

processes develop outside awareness. Most cognition research comes from Western scientists using Western paradigms with Western subjects and it supports this universal assumption. There is, however, a growing body of research challenging the universal nature of cognition. Explanation 2 demands a shift away from control tactics and work-arounds. To function effectively in multinational settings, participants must understand national differences in cognition. Knowledge from cross-cultural research can help shape the skills needed to adapt to national differences.

Human factors and ergonomics professionals need to consider the demands of natural settings. These demands often contrast with more traditional work in cognition (Ross et al., 2002). Traditional research advanced theoretical understanding of human cognition by focusing on a core set of operations including short-term memory, attention span, category judgments, spatial representation, and puzzle solving as commonly described in cognitive psychology textbooks. Cognitive psychologists typically looked at the performance of college students in controlled laboratory settings with relatively brief time scales. This cognition in isolation differs from the cognition often needed in natural settings.

Natural settings may involve interactions between multiple processes, contexts, and players. This makes cognition in natural settings particularly vulnerable to national differences in cognition. This is similar to how each medication can have different effects depending on other medications present in the system. In the last decade, cognitive psychology has pushed the boundaries by considering natural settings. This has required different methods and has identified new mechanisms for cognition. The field of Naturalistic Decision Making has emerged and has extended the science of human cognition (Zsambok & Klein, 1997). As researchers move toward natural settings, they need to extend their methods and approaches beyond those of traditional research for three reasons:

- Traditional research task demands may not map directly onto those of natural settings. Laboratory studies may minimize extraneous pressures while actual practitioners may experience information overload, ill-defined problems and goals, time pressure, and high stakes in natural settings (Orasanu & Connolly, 1993). Some cognitive functions needed in natural settings may be emergent properties not open to laboratory control. Even a sophisticated flight simulator cannot include the life-and-death reality of flight.
- Traditional paradigms usually initially use subjects naive to the task so that experience does not introduce variability. Laboratory tasks can eliminate the confounding effects of experiencem but experience is often important for performance in natural settings.

- Traditional research assumes that cognitive operations are universal. The complex cognitive processes needed in natural settings, however, exhibit variation across national groups. Natural settings are increasingly likely to include people from different national groups.

Natural and laboratory settings provide complementary rather than competing accounts of cognition. Laboratory investigations typically seek to identify and delineate basic processes, whereas investigations in natural settings attempt to describe complex relationships. When cognition is embedded in the world, it is difficult to separate the "purely" cognitive elements from the behavioral and social contexts of cognition.

The purpose of this chapter is to explore cognition in natural settings and to present the Cultural Lens Model, a framework for understanding national differences in cognition. First I describe the Cultural Lens Model. Then I review cultural dimensions that affect performance in natural settings. Finally, I examine implications of the model for understanding vulnerabilities introduced by national differences.

NATIONAL CULTURE AND THE CULTURAL LENS MODEL

A national culture provides a functional blueprint for group member's behavior, social roles, and cognitive processes. (Culture provides rules about food safety, cleanliness, and health care.) It provides the basis for verbal and nonverbal communication, and guidelines for acceptable social behavior and emotional expression. Culture also provides cognitive tools for making sense out of the world. National cultures are rooted in the physical and social ecology of the national group. If the national culture is responsive to the physical and social ecology, it confers a survival advantage. Cultures that lacked effective guidelines for survival in their particular physical and social setting became extinct. Because national cultures emerge from a particular setting, the shared experiences of the setting shape a common vision of the world.

Cultures are dynamic systems. They emerge from a particular setting and they change as that setting evolves over time. Modernization, for example, requires adaptation. Cultures are composed of integrated components rather than a haphazard collection of interchangeable parts. One change has repercussions throughout the system. A culture cannot adapt to the cognitive demands of industrialization without also altering social and educational patterns. Industrialization generally

brings changes in reasoning and education along with changes in family structure. The integrated nature of cultural components means that some cultural elements regularly occur together. These clusters characterize types of cultures. Industrial nations, for example, are likely to show social and cognitive similarities. This definition of culture is consistent with Berry's Ecocultural framework (Berry, 1986; Segall, Dasen, Berry & Poortinga, 1990; Triandis, 1994).

The Cultural Lens Model

The Cultural Lens Model provides a framework for understanding the concept and origins of national culture. Figure 1 shows the Cultural Lens Model. The model assumes that members of a national group, growing up in similar ecological and social contexts, have shared experiences. It also assumes that members of a national group have experienced child rearing based on contextual commonalities. Taken together these similarities, through learning and modeling, generate common behavioral, social, and cognitive patterns. The model captures the dimensions that typify national group differences.

The dimensions provide a lens through which each member of a national group "sees" the world. The lens filters and organizes incoming information, focuses sensemaking, structures planning and adaptation activities, and frames interactions and communication. Because members of a national group tend to share patterns of origin, they also share the way they see the world. This provides common ground during complex cognition in natural settings.

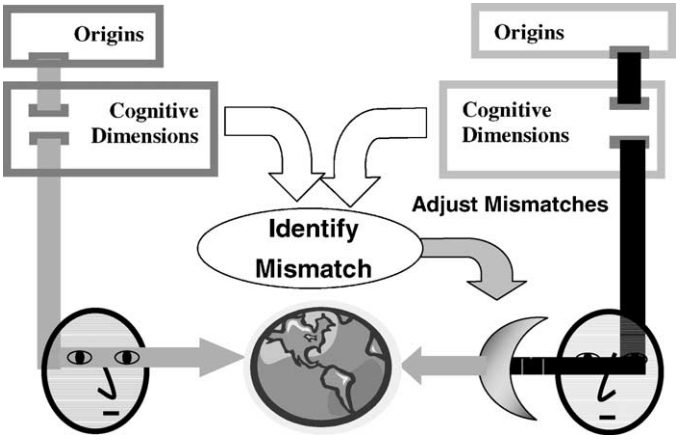

Fig. 1. The Cultural Lens Model.

When people differ in origins and hence in cognition and the behavioral and social context of cognition, their views of the world will not match. Mismatched views of the world can create dissonance and conflict during international interchanges in natural settings. This is seen in multinational peacekeeping efforts where allies struggle to work together on common goals. It is a problem in commercial aviation where standard Western procedures present surprising challenges to non-Western users. While mismatches are a problem, they can also provide clues for working successfully with others in a multinational setting. When mismatches are identified, differences can be accommodated. The application of a cultural lens is designed to prepare people to work in international interchanges.

Origins

Humans, like other species, show phenotypic plasticity: the same genetic endowment can lead to different phenotypic expressions depending on external pressures (Agrawal, 2002). Although all people are born with an essentially identical range of endowments and potential, each group develops with different resources and different physical and social pressures. Common ecological and social pressures lead to common adaptive outcomes (Diamond, 1999). Adaptations include cognition, but also behavioral patterns such as approaches to subsistence and to defense against social or natural threats. Members of a group share the experiences associated with their resources and pressures. These experiences provide common ground and support for group members in their physical and social ecology.

Child-rearing practices are a mechanism for translating resources and pressures into behavior, social roles, and cognition (Berry, 1986; Segall et al., 1990). They shape and maintain the skills, expectations, and goals needed for individual survival and group continuance. Parents use rewards and incentives as well as punishments to establish necessary behavior, social roles, and cognitive patterns (Rogoff & Lave, 1984). Role modeling is another mechanism for shaping adult patterns (Mishra & Tripathi, 1996). From early handling and weaning, to discipline and schooling, the child's plasticity is shaped to the patterns that are successful in the ecological and physical contexts.

Because culture is responsive to ecology, similarities in ecology lead to similar practices while differences lead to different practices. Traditional agriculture depends on soil condition, precipitation, sunlight, and length of growing season. It requires a fixed domicile and adherence to seasonal markers. Group members follow past practices and the guidance of knowledgeable elders. Farmers cannot gamble on planting early or harvesting late. Agricultural groups generally punish risk taking and games of chance. Reward and punishments are geared to developing obedience and conformity. Hunting/gathering groups, in contrast,

tend to live in unstable environments where innovative reasoning confers an advantage. Groups that have competed for resources with hostile neighbors, tend to encourage aggression. As nations move towards industrialization, families become more nuclear and the reasoning more flexible and innovative.

Vision: Seeing the World

Experience within a national group provides the basis of behavior and social customs. It also sets expectations of others. People assume that everyone behaves and thinks as they do. Standards of modesty, food taboos, and religious observances all seem universal. Social patterns of proscribed roles and relationships seem obvious. For most Westerners, it is generally inappropriate for women to expose their breasts in public and also excessive for women to wear chadors in public. The way Westerners define modesty seems just about perfect. It is difficult to see modesty in dress or food taboos as culturally defined until encountering a different culture. When we remain in our own national culture, everything seems natural and correct.

Behavior and social differences make multinational interchanges an enduring challenge. We have only to skim the travel guides to see differences in behavior and customs. Expect a hardy breakfast of meats and cheeses in Sweden. Arrive promptly for meetings in Germany. Anticipate extended pre-negotiation formalities in Japan. Cultural rules for national groups govern terms of respect, acceptable physical distance, polite conversation, and appropriate dress. Just as travelers struggle with language differences, behavioral differences present formidable difficulties.

In the same way that early experience sets expectations for behavior and social roles, it also directs how people see the world. Because those from the same group "see" the world in similar ways, they interpret events and make decisions similarly. They share a "lens" for making sense of the world. The lens provides common values, beliefs, and reasoning scripts that group members use to interpret and react to the environment. Like behavior and customs, logic and reasoning processes seem obvious and optimal.

National differences influence how people make judgments, reason, and make decisions. Peacekeepers from similar nations are likely to select similar strategies. Pilots from similar nations are likely to share judgments about safety compliance. Westerners are generally happier with Western medicine. They do not see themselves as making choices but only as doing the obvious – what should be done. Teamwork requires anticipation of how others will define the problems, respond to unexpected events, and revise ongoing plans. For high-stakes, time-pressured decisions this is difficult even when team members see the world similarly. When team members see the world differently, it can seem impossible.

There have been several efforts to describe differences in cognition and in the behavioral and social context of cognition important in natural settings. These dimensions are culturally dependent and thus highlight barriers to common vision and fault lines along which international interchanges falter. The dimensions emerge from four research traditions:

- Kluckhohn and Strodtbeck (1961) used anthropological methods to identify differences among pre-industrial groups. They noticed that some groups planned for the weeks ahead while others looked to the long-term needs of their grandchildren. The term Time Horizon describes this difference. They also noticed that some groups valued work and achievement while others valued people and relationships. Achievement vs. Relationship captures this dimension. Finally, some groups accommodated to events in the world while others appeared driven to master them. Mastery vs. Fatalism describes this difference.
- Hofstede (1980) used the methods of social psychology to identify differences among employees of a multinational corporation. Some groups were comfortable with uncertainty while others worked to provide definition. Tolerance for Uncertainty describes this dimension. Some groups respected and conformed to hierarchical structure while others showed an egalitarian structure. Power Distance describes this dimension.
- Markus and Kitayama (1991) looked at reasoning across national groups. While most people are capable of a range of reasoning, some groups prefer reasoning grounded in concrete reality while others favor more speculative, hypothesis-based reasoning. The distinction is the basis for Hypothetical vs. Concrete Reasoning.
- Nisbett and his colleagues (Hong, Morris, Chiu, & Benet-Martinez, 2000; Ji, Peng, & Nisbett, 2000; Morris & Peng, 1994) noted that some national groups attributed cause to individual characteristics while others looked to situational factors. Attribution describes this distinction. They also noted that some groups make decisions by seeking distinctions and choosing between options while others seek commonality. Differentiation vs. Dialectical Reasoning describes this dimension (Peng & Nisbett, 1999).

These eight dimensions – Time Horizon, Achievement vs. Relationship, Mastery vs. Fatalism, Tolerance for Uncertainty, Power Distance, Hypothetical vs. Concrete Reasoning, Attribution, and Differentiation vs. Dialectical Reasoning – will be reviewed later.

Mismatches

People can only "see" their culture when they encounter a mismatch between their lifelong patterns of thinking and that of other people. Americans may feel

disconcerted when team members will not critique ideas during a planning session. They may feel irritation when others seemingly "give up" rather than seeking a way around a problem. Different natural settings have particular vulnerabilities for potentially troublesome and disruptive mismatches.

Consider the conflicts created when people who are comfortable with and even prefer to keep procedures and rules flexible work with people who expect procedures and rules that are well defined and provide firm structure. Their ways of "seeing" the planning process will diverge and create disagreement. How specific should plans be? When should the plan be discarded? Is debate and conflict healthy or anxiety producing? It is hard to really discuss differences as each is based on a different but hidden assumption.

Similarly, there are conflicts between people who attribute problems to the dispositions of individuals – perhaps training or work style – and those who look to situational complexity, perhaps organizational policy. Based on these different attributions, each would select a different remedy. Do you provide training to the person you see as responsible or do you review the potentially faulty organizational policy to identify a systems solution? Again, the mismatch can create disagreement.

A mismatch that plagues peacekeeping operations occurs when personnel from Western nations try to help those from emerging nations. In their well-intentioned attempts to support development, they may push for the rapid acceptance of innovative technology. They want to master the difficulties facing the host nation and provide a better life. If the people of the host nation differ in their approach to change, Westerners may view them as lazy and uncaring. The Westerners may be viewed as dominating and disrespectful by hosts who are more fatalistic and relationship oriented.

Finally, when Western designers and engineers develop equipment, they incorporate their own vision of the world. They tacitly assume that all users will share their own reasoning. The equipment will function effectively with Western personnel. Performance, however, may be weak for some non-Western personnel. Westerners may view poor performance as resistant and uncooperative. This is easier than viewing the equipment as inconsistent with the cognition of its users.

These mismatches are typical of the problems encountered in natural settings where nations come together to work and solve problems. In each, participants assume their own vision of the world is correct. Common ground is impossible and coordination suffers. I now turn to the accommodation of mismatches that is a part of multinational interchanges.

Adjusting Mismatches: A Mechanism for Common Ground. When people differ in the cognition and the behavior/social dimensions important for a particular

natural setting and task, there is a potential source of conflict and failure. People cannot adjust mismatches by altering their underlying cognitive processes, i.e. how they think about the world. Differences on dimensions cannot be changed at will because they reflect the demands of earlier experience. Even when the dimensions cause conflict in a new ecological and social context, they tend to persist. Although people can learn new content, it is difficult to acquire new reasoning forms.

It may be possible to adjust mismatches by tapping the mechanisms initially used to create the dimensions in the first place. The Cultural Lens Model postulates a dynamic system in which the outcome of one action provides feedback for future actions and a mechanism for long-term awareness. Drawing on this dynamic, we can seek clues about how to sensitize people to use alternate thinking styles. Children rely on experience and modeling during development (Bandura, 1986). They watch for clues of reactions and events so that they can predict behavior and respond appropriately. Children learn to predict the actions of others by taking their perspective in the form of "make believe." Perspective taking and modeling provides models for adult training. Experiential learning builds on perspective taking. When people can "pretend" alternate patterns, they can see how others see the same situation. As adults become aware of cognitive differences, they are more sensitive to signs of these differences in others. This sensitivity provides an extra "lens" to function more effectively with those from different nations.

Cultural lens-based training can enable practitioners to see the world through the eyes of someone from a different nation. It can facilitate effective interaction by allowing a person to take the perspective of another person. For example, an American may be surprised when a foreign business associate shows distress at a change of plans. With an understanding of different reactions to uncertainty, the American would be able to select adaptive tactics to facilitate continued coordination. This perspective is also useful for formulating procedures, preparing training material, and designing equipment.

Conclusions and Caveats

The Cultural Lens Model differs from other available models in that it is directed at intercultural mismatches in complex natural settings. Unlike most cognition and decision-making research, it can accommodate the cognitive variations introduced by national differences. Unlike cultural and cognitive research grounded in laboratory studies with undergraduates, it can address the complexity of natural settings and the domain expertise of real practitioners.

The Cultural Lens Model provides a framework for understanding the origins of national culture in their physical and social contexts. The ecology is the basis for child-rearing practices. Context and shared experience contribute to national commonality of behavior, social structure, and cognition. Together, collective experience provides a functional blueprint for a dynamic system of integrated behavior, social roles and personality, and cognition. The model captures the way experiences in a national group are translated into a view of the world. It describes the mismatches created when people differ and how knowledge of these mismatches can reduce barriers to multinational interactions in complex work settings. There are five caveats that should be considered when applying the model:

- National culture is only one contributor to individual differences. Also important are differences from social class, genetic endowment, birth order, and the like. Understanding culture can increase accuracy in predicting group trends but cannot predict individual patterns.
- Nations vary in homogeneity and hence in culture-linked characteristics. Southern and northern China differ. Rural Spain is different from urban Spain. Although the model could potentially incorporate within-nation variability, there is little data to specify within-national differences.
- Nations can show ecological and ideological/religious commonality with neighboring nations and also with distant nations. The Cultural Lens Model could incorporate such commonality to extend predictions to unstudied nations. This would require a data base of national commonalities.
- The Cultural Lens dimensions are likely to cluster. Identifying overlapping dimensions would identify clusters of distinct cognitive patterns affecting multinational interactions. Clusters extend the usefulness of the Cultural Lens Models for multinational interactions.
- Nations change over time and over exposure to new ideas. Continual reexamination would be required to maintain the timeliness of dimension placements.

Cultural Dimensions in Natural Settings

Before I describe the implications of the Cultural Lens Model, I present the cognitive and social dimensions. These dimensions underlie the model and are the building blocks for applications in natural settings.

Time Horizon. Time Horizon describes how far ahead people set goals and look to justify their actions. It influences how people assess information, plan, and make decisions. Time Horizon contributes to priorities about resources and

actions. It influences customary responses to delay and impediments to actions. Present-horizon groups seek short-term goals, even at the expense of long-term ones (Adler, 1991). The distant goals and system building are downplayed because it is believed that nobody can see the future (Lane & DiStefano, 1992). In contrast, future-horizon groups will sacrifice immediate payoffs for the expectation of long-term gain. They are less concerned with limits imposed by immediate circumstances (Adler, 1991; Lane & DiStefano, 1992).

> The directors of a Japanese firm and a Canadian firm met in 1984 in Vancouver to negotiate the sale of coal shipments from British Columbia to Japan. The companies reached a stalemate over the length of the contract. The Japanese wanted the Canadians to sign a ten-year contract. The Canadians did not wish to commit a lengthy agreement as a more lucrative opportunity might appear. Whereas the Japanese wanted to plan for the long term, the Canadians were willing to leave the future open for the potential benefits of a more profitable agreement (Klein Associates, 2002, p. 16).

In aviation, routine maintenance takes equipment out of service, reducing immediate productivity to achieve long-term productivity and safety. In some nations, the emphasis is on immediate over long-term productivity. Time Horizon is important in the balance between performance and safety. A present horizon may give on-time departures, and low cancellation rates the highest priority. Maintenance may be ignored when it hampers productivity. This saves money immediately in exchange for low frequency, high-cost problems later on. Safety concerns lead to canceling flights in threatening weather conditions and when defects in equipment are suspected. They lead to expensive and time-consuming error-management approaches. The decisions of pilots and maintenance technicians as well the regulatory policies of managements reflect Time Horizon (Klein, H. A, Klein, G. & Mumaw, 2001).

Training related to aviation safety typically carries an implicit assumption of a future horizon. For this reason it may be incomprehensible to those with a present horizon. Training must bridge the gap between the trainee's Time Horizon and the designer's intent. When a present horizon is characteristic of a national group, it becomes even more important to work with management to expand their understanding of long-term considerations.

In many other work environments, Time Horizon can be important. How are the various tasks prioritized? When do you reassign resources from short-term goals to a longer-term goal? Do you build costly infrastructure or speed production? Time Horizon directs the priorities for emergency management. When participants share Time Horizon, the process will be easy.

Mastery vs. Fatalism. A mastery orientation is based on the belief that people are dominant over nature and can control their environment (Kluckhohn & Strodtbeck, 1961). This means that with enough time, money, and thought, almost

anything can be achieved. This personal efficacy leads to seeking solutions to problems and working to implement change. Setbacks are seen as signals to try other routes or other methods. People with a mastery orientation are less likely to accept events as being beyond their control. Those who hold a fatalistic orientation respect the external factors that control their lives (Kluckhohn & Strodtbeck, 1961; Lane & DiStefano, 1992). To the extent that events are beyond one's control, change is ineffectual or even inappropriate. Fatalistic thinkers strive for acceptance and adaptation rather than problem solving.

A sense of mastery leads people to try to overcome seemingly impossible difficulties. North Americans and most Western Europeans show mastery (Lane, DiStefano, & Maznevski, 1996). They respect a "can do" attitude. Our folklore is filled with rags-to-riches stories, tales about people who let nothing take them from their quest. Asian cultures are more fatalistic (Wright & Phillips, 1980). In the Sioux City landing of an inoperative aircraft, the crew would not stop trying to master a set of fatal flaws. In a Guilin, China crash, a crew appeared to accept as inevitable a potentially solvable irregularity.

> In 1989, the crew of United Airlines Flight 232 experienced an unusual confluence of failures. Three critical systems were lost when an engine failed and exploded, destroying the hydraulic systems. They had no ailerons to bank the airplane, no rudder to turn it, no elevators to control pitch, no leading edge flaps or slats to slow the airplane down, no trailing edge flaps for landing, no spoilers on the wing to help get down. On the ground, they had no steering, nose wheel, or tail, and no brakes. The Flight Manual had no contingency plan for recovery. Flight crewmembers were experts but none of them had any experience in this situation. They certainly understood the seeming hopelessness of the situation. This crew, nevertheless, managed to land in Sioux City. They found new uses of existing devices; they coordinated innovative procedures and brought down a fatally flawed aircraft (Klein, H. A., Klein, G. & Mumaw, 2001, pp. 8–9).

> The 1992 crash of a 737 occurred at Guilin, China after one of the two thrust levers got stuck. As the other lever moved forward, it led to split throttles. The position of the throttles is, in itself, not a strongly salient feature. The airplane, however, started to lose control. This performance change should have been the tip-off. The pilots appeared as if they did not respond to the performance change and scan for the simple malfunction. Proper detection would have allowed the crew to move the thrust lever that was stuck – a correction that would have regained control of the aircraft. They didn't do it (Klein et al., 2001, p. 15).

Medical decision making can also depend on the balance between Mastery vs. Fatalism. Although death is inevitable, medical science has made great strides in the mastery of disease. Many medical conditions have no standard procedure and multiple courses. Western medicine tends to prolong treatment even when the treatment is painful, expensive, and untested. We are more likely to adopt aggressive means to a cure and talk about "the good fight." Eastern medicine is

faster to provide palliative care for patients with life-threatening conditions. This means comfort and compassion over heroics. Easterners are more apt to accept and adapt to fatal illness.

Mastery vs. Fatalism influences how groups respond to threat and the cognitive resources they devote to change. The accommodation of fatalism may seem like a lack of concern for personal safety. The safety procedures and training of mastery may seem like an arrogant disregard of the inevitable.

Achievement vs. Relationship. People differ in their emphasis on Achievement or Relationship. This distinction corresponds to Kluckhohn and Strodtbeck's (1961) Doing or Being. It affects the way people approach life, work, and relationships. For achievement groups, work related activities are a central focus and accomplishment a defining goal. Western thinkers are generally achievement oriented. They look for task demands and how best to accomplish them. In relationship groups, cultures, interpersonal dynamics, and nurturing relationships are central focus.

Differences in orientation can be a barrier during multinational interchanges. This arises when achievement people, who opt for task-centered interactions, work with relationship people who prefer nurturing, interpersonal interchanges. Those high in achievement believe that they can hasten change when plans are outlined, target dates set, and frequent reports made (Adler, 1991). Relationship-oriented people believe in allowing change to happen at its own pace without rushing things. Speeding up change is considered unwise. Differences in orientation interfere with ongoing operations when they are not recognized and managed. The conflicts and misunderstandings are seen in this interview record.

> For American aviation personnel, keeping aircraft safely in the air and on schedule is a high priority. For them, maintenance personnel must be ready to support this goal. In China, workmen will stop to socialize or have lunch instead of doing a needed repair. An American Field Service Representative interpreted this behavior as showing that the workers do not understand the big picture of what the task implies. But for those workers, maintenance can wait but relationships with people cannot be postponed.

Here is another example:

> Army Major: "I was doing an exercise with the Italians. Their job was to provide security for the camp. To Americans, this means watching 24 hours a day, 360 degrees. The Italians would come in and do a pretty good job. Then mealtime would come. They would all leave to eat and drink and socialize. This was alien to Americans. At mealtime, we didn't stop. We rotated through and the job got done" (Klein Associates, 2002, p. 9).

Achievement vs. Relationship influences work behaviors by setting priorities and framing decisions. Are team members critical or protective of the suggestions and

assumptions of others? What are expectations for time use during work hours? How much attention is to be given to the needs of individual over the needs of the task? When participants share orientation, the process will be easier.

Power Distance. Power distance is the extent to which members of a group expect the uneven distribution of power (Hofstede, 1980). The differences in interpersonal power and influence between superior and subordinate team members reflect differences in this dimension. This includes the acceptance of unequal distribution of power by institutions (Dorfman & Howell, 1988). Low Power Distance was associated with egalitarian working patterns and team interchanges. Those with low Power Distance expect to listen to others based on the merit of their ideas not on their rank. They expect that their own ideas will be evaluated based on merit. In contrast, those with high Power Distance expect that those with power will provide leadership and make decisions. Those who hold power maintain their rank in decision making. Power Distance has received considerable attention in commercial aviation.

> A Boeing representative reported that on the airport employees' bus in Saudi Arabia, the Captain always sat in the front row, and the First Officer in the second row. The cabin crew never talked to the Captain. He contrasted the situation with what he would find in the U.S.: "Because the Captain's most important role is as manager, a lot is lost here. An American pilot will talk with the crew, which facilitates communication in flight. The Saudi Arabian style is not compatible with Crew Resource Management (CRM). The Saudi Arabian pilots do not appreciate this" (Klein et al., 2001, p. 12).

> The cockpit voice recorder told the story. During a flight in China, it became clear that the Captain had a bad attitude director indicator. The First Officer had a good attitude director indicator. Nevertheless, the Captain persisted in using his indicator and crashed the airplane. It would have been unseemly for the Captain to have to depend on the First Officer (Klein et al., 2001, p. 12).

> Chinese pilots take off in a storm if the air traffic controller says, "take off." If an American pilot had to take off, they would order additional fuel in case they are diverted. The Chinese would never request additional fuel. It is not their job to decide to take off nor is it their job to decide on needing extra fuel. Chinese do not request to divert an airplane, even in an emergency. If they are told they can land, they attempt a landing (Klein et al., 2001, p. 10).

In multinational collaborations, allies may have limited experience working together and they may need to work in different locations. The structure and the lines of command for decision making and for implementation may cross national boundaries. Several leaders may need to coordinate actions to maximize productivity. This works best when everyone adheres to and respects the same command structure regarding responsibility for decisions. If participants differ in Power Distance, they may struggle to define a working relationship rather than accomplishing goals. When operations are complex, it is sometimes lower ranking

technical staff that has the expertise to make the best decision. Discrepancies in Power Distance, can interfere with the use of expertise and can delay or compromise action.

Tolerance for Uncertainty. Complex natural environments can include considerable uncertainty. Tolerance for Uncertainty describes how people function in the face of uncertainty. Those with low Tolerance for Uncertainty experience uncertainty as stressful and work to avoid it. They seek stability by adhering to formal rules and ritualistic behaviors (Lane et al., 1996). Those who are low in Tolerance for Uncertainty prefer detailed plans and abhor incomplete information. They resist changes because it is disconcerting and they feel unsettled until there is a final decision (Helmreich & Merritt, 1998). Disagreement among team members is stressful because it can generate questions and uncertainty. People low in Tolerance for Uncertainty value consensus (Lane & DiStefano, 1992).

In contrast, those who are high in Tolerance for Uncertainty are comfortable with ambiguity and incomplete information (Dorfman & Howell, 1988; Hall & Hall, 1990; Hofstede, 1980). They adapt readily to change and act with limited information (Hall & Hall, 1990; Helmreich & Merritt, 1998; Lane & DiStefano, 1992). Those high in Tolerance for Uncertainty may ignore rules and rituals or treat them flexibly because they view them as ineffectual (Helmreich & Merritt, 1998). Those high in Tolerance for Uncertainty accept dissent and are not threatened by deviant ideas.

This dimension was illustrated in the Operation Harvest example provided earlier. In this example, those with low Tolerance for Uncertainty want to have meticulously structured operations where all details are specified. The motto was “a dull day is a good day.” In contrast, those who are high in Tolerance for Uncertainty are comfortable with the uncertainty of the general plans. They are more likely to “play it by ear.” They are also more likely to encourage team members to identify and express problems with planning along the way. “Over planning” is viewed as counterproductive because you can never anticipate everything.

The national differences in flight check rides illustrate this dimension. When the U.S. Federal Aviation Administration assesses a pilot’s skill, each pilot must perform well during structured situations and surprises. The assessment requires flexible responses and reflects high Tolerance for Uncertainty. Pilots are expected to make good decisions quickly in the face of uncertainty. During a Japanese check ride, pilots must perform precision responses during specified test situations. Low Tolerance for Uncertainty personnel see skill assessment as a well-defined task with unambiguous rules. High Tolerance for Uncertainty people are comfortable with general instructions and some flexibility to alter procedures as they go along.

Tolerance for Uncertainty influences many aspects of work in natural settings. How much information is needed before you are willing to identify a problem? How much detail should a plan have? At what point are you willing to adapt ongoing plans?

Hypothetical vs. Concrete Reasoning. Hypothetical thinkers use mental representations of future events to consider alternate outcomes (Markus & Kitayama, 1991; Tetlock, 1998). They examine situations by going beyond the actual occurrence. They ask "what if" questions. External events are analyzed in the abstract and do not have to be grounded in reality. It is a mental playing out of alternative strategies to imagine different outcomes (Markus & Kitayama, 1991; Roese, 1999; Tetlock, 1998). Most Westerners use hypothetical thinking to make plans and to examine their implications. They separate reasoning from reality to consider options in an abstract, hypothesis-driven manner (Markus & Kitayama, 1991).

Concrete reasoning is a different approach to the same goal (Markus & Kitayama, 1991). Those people respect the constraints imposed by context and carefully integrate those constraints into their thinking. Reasoning is grounded in past personal and national experience not in mental simulation activities. Concrete thinkers work to improve future performance in similar contexts. Rather than abstract speculation, concrete thinkers review past events and their context in order to improve future performance. Concrete reasoners view hypothetical thinking as distorted because it is not grounded in reality.

The differences in this dimension can be seen in the patterns of terrorists. Intelligence officers know that all terrorist groups are not the same. Some have a well-known modus operandi – always kidnapping or perhaps using explosives. Each attack is meticulously planned and information officers can trace the evolution of technique over time. If the group makes a mistake, they will correct it in their next attack. Other groups go for the most available target or approach at the time. A single approach cannot be identified. Their work, though flexible, is not precision but opportunistic and unexpected (Klein Associates, 2001). These two approaches are both potentially successful. The first pattern exemplifies concrete reasoning and builds on past experiences to generate precision plans. The second provides flexibility to take advantage of opportunities. Deterring these two patterns of planning requires different strategies. One trainer told us:

> In an emergency, U.S. pilots use Plan A and keep trying to adjust it and make it work. But they are ready to switch if that first plan fails. I've had a Chinese student in the simulator where the situation is very different. There was an engine fire but the engine was not failed, and the indications did not suggest a failure. The student responded by rote as if there was an engine failure and crashed. He didn't use visual cues. When something goes wrong, the Chinese pilots have trouble thinking hypothetically. They learn flying as procedural – Step 1, Step 2, and Step

> 3 and don't try to figure out what is happening. If they start with Plan A, they finish with Plan A. In an emergency, U.S. pilots always have Plans A, B, and C in their head (Klein et al., 2001, p. 14).

U.S. pilots use hypothetical reasoning to achieve flexibility. During times of rapid and unanticipated change, hypothetical thinking will be more successful. One cost comes when different crewmembers have different backup plans and switch at different times. This flexibility also comes at the expense of precision. Concrete reasoning leads to increases in the precision and synchronization of thinking. When times are stable, context-based, concrete reasoning tends to be more effective and reinforced. The precision is achieved at the expense of flexibility.

Attribution (Root Cause vs. Systems Approach): Faced with complex pressures or opportunities, people assign probable cause or describe dynamics. Attribution focuses attention and narrows the selection criteria for approaches or remedies. National groups differ in their Attribution of causality (Choi, Nisbett & Norenzayan, 1999; Ji et al., 2000; Norenzayan & Nisbett, 2000; Peng & Nisbett, 1999, 2000).

Some people who use root-cause Attribution attend to the unique characteristics of the person or object. They locate responsibility primarily in the individual (Choi et al., 1999). People with root-cause Attribution consider retraining and counseling to be an appropriate remedy. They expect employee selection and promotion to be based on skills and knowledge.

Those with a systems approach to Attribution adopt context-dependent and occasion-bound thinking (Schweder & Bourne, 1992; Wegner, 1987). When a problem is detected, the cause is attributed to the broader context and holistic solutions are implemented. Those with systems Attribution are uncomfortable with retraining that targets specific individuals. They favor efforts to modify organizations and procedures while placing less weight on selection standards. Everyone may undergo extra training or the company may seek organizational changes.

Attribution influences interactions in organizations. Those with a root-cause Attribution view themselves and others as composed of separate characteristics. People may see a colleague as an effective technician but weak in organizational skills, for example. They do not view a negative statement about one capacity as demeaning to the whole self. For those with root-cause Attribution who compartmentalize their traits and abilities, loss of face is an uncommon emotion. They work to avoid occasional failures, but not because it is a personal threat. In contrast, those with a systems Attribution view a negative statement about their work as a threat to their integrity. Loss of face occurs because of a criticism.

Such reasoning means that people will work to avoid losing face. This may mean covering up problems and failings. They are careful in their words to others because they assume others see the world in this way.

In team environments, differences in comfort with negative statements can be a damaging barrier. Those with root-cause Attribution view feedback as a contribution to improvement. Team members may ask others how they are doing and sometimes even elicit negative reports for their own benefit. This ordinary process does not translate well for those with Systems Attribution. It may be construed as an indictment of the person not an appraisal of specific capacity. This can disturb teamwork in multinational groups.

Differentiation vs. Dialectical Reasoning. Natural settings are often complex with multiple and sometimes incompatible goals. This leaves practitioners with tough choices. There are national differences in reasoning about such contradictions (Peng & Nisbett, 1999). Consistent with the Greek and Roman tradition, differentiation reasoners work to understand contradictions by separating, analyzing, and evaluating distinct qualities. They sharpen distinctions by highlighting the strengths and weaknesses of each view. Polarization of contradictory perspectives is viewed as exposing the root cause or best option. There may be secondary causes or options, but the focus is on the most important.

Dialectical reasoners evaluate ideas by seeking their connections rather than sharpening distinctions. They avoid conflict (Chu, Spires, & Sueyoshi, 1999) and believe that different perspectives may contain truth. Consistent with Eastern philosophic tradition, dialectical reasoners seek harmonious, intermediate positions, deny dichotomous descriptions, and retain elements of different perspectives (Peng & Nisbett, 1999, 2000). They see differentiation as closing out options. Maintenance personnel feel pressure to keep equipment in the air at the same time that they feel pressure to ensure the safety of every aircraft. A pilot strives to arrive on time at the same time that he or she is committed to arriving safely. Why choose between being safe and being on time? Do you weigh alternatives and choose or seek an integration of all goals?

This dimension can hinder team interactions during ongoing activities. Differentiation reasoners view each person as potentially having strong and weak areas of performance. They isolate one characteristic from the person as a whole and so do not view criticism on one characteristic as criticism of the person. They value frank and even critical analysis of individual performance. Dialectical reasoners consider the person as a whole. For a dialectical person, critical comments about individual characteristics are considered to be intimidating and demeaning to the whole person. They avoid direct criticism and may, when working with Westerners, even hide errors to avoid it.

IMPLICATIONS OF THE CULTURAL LENS MODEL: FIVE INTERCULTURAL CHALLENGES

Practitioners can not simply apply research findings gleaned from Western research and expect help in multinational environments (Klein, in press). The complex cognition required in natural settings can require that practitioners adapt equipment, procedures, and instruction to the cognitive characteristics of multinational participants. Further, practitioners cannot simply borrow research findings from controlled laboratory settings and expect help in natural settings. Five cognitive challenges – problem definition, planning, prediction, coordination, and training – reflect the complexity that distinguishes natural settings from traditional laboratory paradigms. I now review these intercultural challenges and suggest their vulnerabilities to the national differences outlined above. While I review these five sequentially, they are often undertaken iteratively or in parallel.

Problem Definition

Problem definition includes both problem detection and sensemaking. In laboratory paradigms, problem detection is usually unnecessary. The experimenter specifies the problem. In natural domains, such as medicine, weather forecasting, and intelligence analysis, the practitioner encounters an unusual pattern. A patient mentions occasional abdominal pain, dizziness, and thirst; blood pressure is elevated but blood sugar average; the physical exam reveals unusual neurological responses. There may be a lot of information but no clear pattern.

Making sense out of an array of anomalies requires the active integration of elements. The practitioner must organize the information into a meaningful story. During difficult incidents, people need expertise to appreciate the cues and patterns (Klein, Pliske, Crandall & Woods, 1999). They need to continually reframe their interpretation (Klein, Wolf, Militello & Zsambok, 1995). The physician, for example, may order additional tests. This is an active view of problem detection rather than an accumulation of discrepancies until a threshold is passed.

Weick (1995) described how individuals and organizations come to understand confusing events as a process of sensemaking. Practitioners must construct an explanation for anomalies and use that construction to define what counts as relevant data. This is not a mechanically generated interpretation. It requires the use of inferences to achieve interpretation. This active view of problem definition means that it is vulnerable to differences in cognition. This vulnerability is described for several dimensions below.

Tolerance for Uncertainty influences the threshold for initially reacting to anomalies. Problem detection is most likely to occur when people are prepared to reframe their understanding of the situation (Klein et al., 1999). Those who are high in Tolerance for Uncertainty change more easily and select a new explanation with less data. A person with a low Tolerance for Uncertainty is more reluctant to change and more likely to wait for more information. Each pattern carries its own strength and weakness. People who are high in Tolerance for Uncertainty are comfortable reframing situational understanding but slow to settle on a final interpretation. People with low Tolerance for Uncertainty are more complete in their review of information but tend to stick with an interpretation once accepted.

Those with a sense of mastery assume that they can make sense of an ambiguous situation and that there is a solution to detected problems. They initiate an active process of discovery and aggressively construct explanations. In contrast, a fatalistic orientation leads to a passive process of problem detection and sensemaking.

Those with hypothetical reasoning typically use this as a mechanism for sensemaking. Mental simulations allow them to evaluate their efforts to organize confusing events. Concrete reasoners, in contrast, would seek comparable cases for sensemaking. This approach would generate a different outcome.

Attribution is expected to contribute to the problem detected. For the person with root cause Attribution, individual contributions are very salient. For a person with systems Attribution, situation contribution would be expected to have a low threshold for detection while individual contributions may be outside the radar. Differences in Attribution lead to the identification of different problems. This is important because problem identification directs the search for solutions.

Differentiation and dialectical reasoners are expected to differ in their sensmaking. Differential reasoners polarize potential explanations and seek the best explanation. People who show dialectical reasoning do not try to fit options into categories. Imposing abstract category structures is seen as distortion. They work to fit all data into a coherent picture. Differentiation vs. Dialectical Reasoning influences the explanations considered and the criteria for accepting them. Whereas, differentiation reasoners think of problems as anomalies suddenly arising and easily solved, dialectical reasoners see problems as long present, but only recently noticed. They do not seek a “quick fix” but rather the creation of conditions needed for a return to balance.

Planning

I use “planning” to include initial planning, ongoing adaptive replanning, and the decisions these entail. Traditional laboratory research often assumed that people

first generate a comprehensive set of options. Consistent with a multi-attribute utility analysis, they then detail and evaluate the options using a common set of criteria. In natural settings, experienced planners must often go beyond the mechanisms studied in laboratories (Lipshitz, 1993; Schmitt & Klein, 1996). They may lack the time and resources needed to generate a set of options and then compare each to a criterion. Experienced planners may use past experience to generate a plan as they make sense of the situation (Klein, 1998). Alternately, they may use a constructive process to recognize and synthesize potential leverage points. This strategy uses mental simulation to test and revise the plan. Both strategies meet the stressful planning demands of some natural settings. As planning demands increase, so does vulnerability to national differences. Four dimensions illustrate this vulnerability.

The nature of plans is dependent on the Time Horizon of the planner. Those with a future horizon make plans that consider longer term consequences and goals more than those with a present horizon. Their mental simulation strategy extends further in time.

Tolerance for Uncertainty influences planning. Planning often presupposes an assessment of risk related both to the situation at hand and the proposed remedy. Both judgments depend on the Tolerance of Uncertainty. Those who are low in Tolerance for Uncertainty want more information before formulating plans. They generate detailed, fixed plans and may be reluctant to engage in improvisation and adaptation. They may see people with high Tolerance for Uncertainty as impulsive. People with high Tolerance for Uncertainty are comfortable initiating plans with incomplete information and adapting their plans as additional information becomes available. People with low Tolerance for Uncertainty are uncomfortable with this seemingly casual planning. Differences in this dimension are even seen among Westerners as is clear in an interview with a U.S. military officer.

> The British plan and plan and plan . . . Let's say you need to move troops quickly. The British would have all these maps and all this stuff before they'd do anything. Americans would start packing. We'll plan the best we can and we'll kinda shoot from the hip, because it's time sensitive. The British would rather be late. They want every kind of weird contingency laid out, like what happens if we have real severe weather? In a military operation you've got to leave some stuff to chance, and the Brits don't like to leave anything to chance (Klein Associates, 2002, p. 12).

The clash between high and low Tolerance for Uncertainty is common in multinational operations. There is conflict between members of national groups who want everything clearly and firmly pinned down and those who grow impatient with what they see as "micromanagement."

Planning is vulnerable to differences in Hypothetical vs. Concrete reasoning. Concrete reasoners develop plans by identifying the precedent case that provides

the best match. The result would be a time-tested plan rather than an innovative plan. Hypothetical reasoners see planning as a constructive activity of recognizing and synthesizing leverage points (Klein, 1998). Hypothesis testing rather than concrete comparisons is required and mental simulation forms the basis of evaluation. Their plans would be innovative at the expense of safety.

Attribution can contribute to differences in planning. Those with root-cause Attribution seek causal factors in individual characteristics. Thus plans must address individual characteristics. Training is seen as correcting individual limitations. Those with system Attribution address plans to the broad environment considering organizational and systems changes. While those with systems attribution may see the focused plans of root-cause thinkers as shallow, root-cause thinkers may view the plans of the systems approach thinkers as unfocused and illogical.

These differences create contention and mistrust during collaboration. The differences, however, have the potential for enriching the planning process by incorporating the strength of divergent cognitive approaches.

Coordination

While individuals are typically the unit of analysis in laboratory research, the complex tasks found in natural settings can require more people and a broader range of skills and competencies. During surgery, the physician focuses on a particular procedure. At the same time, the anesthesiologist monitors the patient to detect and manage problems in life functions. A nurse ensures that equipment is available when and where it is needed. Each professional needs different information and has different responsibilities. Coordination is essential because of the high-pressure, interdependent demands of surgery. Team members must monitor each other, along with the overall team status, to make needed adaptations. Even space is limited and team members need to anticipate the physical location of others. These dynamics are not readily captured in the laboratory.

National differences emerge as a source of friction in multinational teams (Thomas, 1999). Teams depend on a shared vision of the world. Team members need to have common expectation for how information will be shared and how decisions will be made. Research with multinational teams suggests the importance of culture for teamwork effectiveness (Adler, 1991, 1997; Granrose & Oskamp, 1997; Helmreich & Merritt, 1998; Lane & DiStefano, 1992).

Fatalism vs. Mastery influences how team members react in the face of threats. Those with a sense of mastery will actively identify and modify barriers. In contrast, fatalism may lead to seeking adaptations in the face of perceived limitations.

Those with a sense of mastery may view fatalism as defeatist and ineffectual. Those with a sense of fatalism may view mastery as unrealistic and fanciful.

Team members who rely on hypothetical reasoning use divergent thinking and option generation at the expense of concrete, context-sensitive solutions. They expect others on their team to do the same. In contrast, those with concrete reasoning might show a preponderance of precedent-based solutions at the expense of flexible solutions. They might find the hypothetical thinking of their peers to be groundless. This difference interferes with a coordinated team planning.

Differences in Attribution can contribute to conflict. Faced with a problem to solve, a person with root-cause attribution will look for the responsible person and characteristic. Those with a systems approach Attribution will look to the broader context of the problem. A team will struggle to solve a problem when they lack a common understanding of the nature of the problem. Differences in the use of criticism can also hinder coordination. Those with root-cause Attribution encourage critical analysis of ideas at the same time that those with a systems Attribution find this criticism demeaning. This is not an easy difference to bridge.

Variations in Differentiation vs. Dialectical Reasoning present a parallel obstacle. Differentiation reasoners approach cognitive tasks by identifying and prioritizing options. They would expect others to make discriminations and carefully contrast options. The dialectical reasoners would try to integrate information into comprehensive picture. Differentiation reasoners might accuse their teammates of being indecisive, "*Why can't they settle on the problem so we can solve it*?" Their dialectical teammates would accuse them of being narrow and limited, "*Why this rush to judgment? Real problems are never that simple*."

Power Distance is a last example of the pervasive importance of national differences during coordination. Teams in low Power Distance nations are egalitarian with members free to contribute their own ideas and critique the ideas of others. High power distance is associated with a firm command structure with team members expecting and wanting direction. Multinational military operations are plagued by differences in Power Distance. A U.S. officer reported, "*They won't do anything unless I tell them exactly what to do and how to do it*." A man under his command sees it differently, "*He is my officer. He must make the decisions. I can't do that*."

Teams whose members differ on any of the dimensions may waste time and resources struggling with national differences. These barriers to coordination detract from their real tasks and compromise team effectiveness. When people have a shared vision, this supports teamwork. The shared national vision may also

lead to a preferred pattern of teamwork. This analysis of within nation similarities and between nation differences questions the universality of current teamwork models. It suggests that the optimal functioning of a team will depend on national differences.

Prediction

Predicting the plans and actions of team members is vital for coordination. It is also important to predict the decision and actions of allies and partners, international users of technology, and adversaries. When people come from the same national group, they are better able to predict judgments, decisions, and limitations. This mutual knowledge, or common ground, allows the detection and repair of communication breakdowns (Clark & Brennan, 1991). In the Sioux City landing incident, the pilots were American and so likely to share values on the dimensions. This allowed them to anticipate actions, frame effective communication, develop and adapt plans, and provide useful feedback. This incident would have been even more difficult with a multinational flight crew. The dimensions that provide common ground within a national group can introduce mismatches between national groups. I review three natural settings to illustrate the role of the cognitive dimensions.

Air traffic controllers are most effective when they can adapt their directions to the cognitive characteristics of a flight crew. Crews from a high Tolerance for Uncertainty nation, for example, may be slow to acknowledge problems. Air traffic controllers may need to be more attuned to other signs of trouble and more assertive in their directives. During emergencies, crews from high Power Distance nations will respond to directives differently than those from low Power Distance nations. High Power Distance crews may respond best to authoritarian directions while low Power Distance crews will work better with egalitarian interactions. Air traffic controllers need to anticipate that pilots from fatalistic nations may be less aggressive in seeking solutions than would a crew from a mastery nation.

Technological innovations intended for international markets should provide the design features preferred by people in those markets. When the cognitive assumptions of the equipment and instruction match the cognitive characteristics of users, demand for an innovation is maximized. Early in the design process, these cognitive features must be predicted. An understanding of national characteristics can support predictions. Nations with future Time Horizon, for example, select technology with an eye to long-term integration. They are concerned with the continued availability components and technical support. Tolerance

for Uncertainty can help predict the desired timing and specificity of feedback provided by the equipment. Errors in predicting needs and potential mismatches can undermine technology dissemination no matter how well the technology is designed for the originating nation.

National security depends on anticipating the actions of adversaries. Military leaders need to predict the decision making of hostile armies as well as that of paramilitary and terrorist groups. Adversaries high in Power Distance are expected to act quickly and decisively in emergencies but fall apart when their central command or leadership is disrupted. Low Power Distance nations or groups may be initially slower to react to surprises but suffer less when communication is disrupted. An adversary with hypothetical reasoning can adapt more readily to unexpected events but will lack the precision of an adversary more dependent on concrete reasoning. Diplomats and military leaders need to predict the impact of their messages. An assertion intended as hypothetical and conciliatory may be interpreted as concrete and provocative. An adversary with a mastery orientation is expected to be more vulnerable to different persuasion information than one with a fatalistic orientation. A pamphlet warning about the massive force might firm the resolve of a mastery adversary but destroy the will of a fatalistic nation. A statement meant as describing a long-term goal might be interpreted as an immediate threat. Increased knowledge of cognition dimensions may improve efforts to predict actions, disrupting factors, and vulnerabilities.

Training for Multinational Effectiveness

Training is important in two distinct ways. First, ongoing training is often critical for competent performance in natural settings. Training is needed to accommodate the rapidly changing technology of software, medical devices, aviation, communication, and weaponry. When technology is used internationally, instructional methods and materials are best if they reflect the cognitive characteristics of intended users. Several dimensions illustrate potential interference with existing training approaches.

Those groups low in Tolerance for Uncertainty are uncomfortable with self-paced and flexibly structured training. It is a poor match with their need for structure and definition. Their feeling may be, “If this instructor knows what he’s doing, why am I supposed to decide how to complete this course?” Instructors need to bridge this mismatch if they intend to use self-paced material. Alternately, knowledge of national differences can direct the selection of a more appropriate learning tool.

High Power Distance groups are most comfortable with formal teaching styles. An instructor reported, "I'd always had students who questioned and pushed me. I can say anything to these guys and they just write it down." Some instructors have developed pre-training exercises designed to encourage more interactive learning. In the same way, low Power Distance professionals find it demeaning to have instruction delivered in a way they view as authoritarian. They expect to have their ideas heard. Good training may be lost when it does not match the user.

Much scenario-based training depends on working through simulated problems. The trainee may be encouraged to think through alternative solutions and speculate on likely outcomes. One goal is to foster flexible thinking. While this is effective with hypothetical reasoners, it may be ineffectual and baffling for concrete reasoners. They typically learn by examining past cases to understand actual outcomes. Scenario-based training may seem like "ungrounded mind-games."

The second importance of training is as a tool for overcoming barriers seen during international collaboration and teamwork. The Cultural Lens Model can provide the perspectives of other groups. It can provide a "lens" to adjust for mismatches in cognition and in relevant behavioral and social dimensions. This may help multinational collaborators and team members identify, appreciate, and manage national variations. It might also convey an understanding of the strengths and limitations of allies, potential product users, and adversaries.

Team members need to identify and accommodate mismatches between their own cognition and that of others on their team. The Cultural Lens Model has guided the development, implementation, and evaluation of a scenario-based training program (Klein & Steele-Johnson, 2002). Tolerance for Uncertainty and Analytic vs. Holistic reasoning were targeted for training. Analytic vs. Holistic Reasoning includes Attribution as well as Differentiation vs. Dialectical Reasoning. Training for each dimension lasted less than two hours and included definitions, examples from international settings, and role-playing exercises. There were increases in knowledge, positive attitude, and accuracy of model-based predictions.

Based on this initial success, the training concept was then used to develop materials multinational peacekeepers to be used prior to deployment. Initial trials at the Stabilization Force (SFOR) Headquarters in Bosnia supported the efficacy of the approach (Hahn, Harris, & Klein, 2002). The training focused on personnel from Western nations. An additional validation study also demonstrated the impact of using a Cultural Lens Model based training program to increase functional understanding (Sutton, 2003).

Enthusiasm and demand for multinational training far surpasses current training technology. Practitioners in domains as varied as the military, commercial aviation, medicine, and business want to function more effectively. Much of the

available training, however, focuses on behavior and customs. The Cultural Lens Model offers an approach that is grounded in the nature of national differences and is directed to the cognitive demands of natural settings.

Cognitive Psychology Through a Cultural Lens

Practitioners now have the benefit of decades of laboratory research on human cognition. The research has advanced theoretical understanding of human thought processes and functioning. More recently, considerations of cognition in natural settings have extended the science of human cognition far beyond the laboratory. The inclusion of national differences in cognition is an emerging opportunity for cognitive psychology. The majority of research upon which cognitive psychology rests has used subjects from the United States, Western European, and English-speaking nations. Yet national groups show qualitative differences in cognition. As cognitive psychologists better understand these differences, they see the limitations of Western cognitive psychology. It can no longer be assumed that all people think, make decisions, plan, and make sense, in the same way. Human factors and ergonomics professionals must go beyond their own projections about how people from other nations cooperate in work situations, use Western technology, develop new skills, and negotiate.

Commercial aviation and other areas of technology transfer are increasingly international efforts. A small number of manufacturers, primarily from the West, design and produce commercial aviation equipment for the international market. The same organizations develop procedures and training programs for both maintenance and operational staff. This concentration has supported industrial growth, safety, and international standardization. It has also meant that cognitive differences across national groups are hidden or easily ignored. As human factors specialists learn to incorporate national differences into the design of equipment and training, the industry will be better able to improve productivity and safety worldwide.

Peacekeeping and humanitarian efforts have become increasingly international allowing the pooling of resources and expertise. At the same time, the demands for multinational coordination increase the difficulty of problem definition, planning, and training. Practitioners cannot assume others will share our vision. Multinational teams perform best when participants understand how others on their team "see" the situation. This demands common ground and shared understanding – a real challenge for multinational teams.

Human factors professionals cannot ignore national differences in cognition. We also cannot ignore the strength that multinational interchanges provide. We will

need knowledge to capitalize on what such interchanges can offer. We need tools to avoid the barriers and problems introduced by national differences in cognition. We can better serve the needs of business, aviation, and the military, as well as other natural settings, as we learn to tap the skills and resources of people around the world.

The study of national differences in natural settings has opened up a new and exciting window on cognitive processes as they play out in practical, complex, and often demanding domains. As more work domains cross national borders, there will be a greater need for tools to support common ground and shared vision. The Cultural Lens Model can serve as a framework toward this goal.

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